Sustainable Cities

Dhasharath Shrivathsa, Ezra Varady, Gracey Wilson

January 23, 2017

Contents

Abstract

In this project, we built a model of an American city using real data in order to determine how the city might make improvements for sustainable and positive growth. We chose to study and model the city of Oakland, California because of its appropriate population size, accessible data and consistent openness to external suggestions for improvement. By utilizing real data from the city of Oakland's public databases, we were able to develop a growth plan that supports the three main ideals of "Smart Growth" initiatives. Potential goals for the city to achieve include increasing the amount of local affordable housing, redistributing commercial space and development, and optimizing the allocation of public parks.

Part I

Background

0.1 Smart Growth

An initiative called Smart Growth is dedicated to supporting towns and cities become more "economically prosperous, socially equitable, and environmentally sustainable."[1] In an effort to support this initiative, our proposal for positive, sustainable growth focuses on these ideals.

0.2 City Choice

With a willingness to listen to external input, accessible data, and an appropriate population size, the city of Oakland, California is a prime community for us to examine.

The city of Oakland has a desire to improve. With a track record of actively soliciting suggestions from local citizens and external viewpoints alike, the city is interested in facilitating discussion and collaborating on ideas for progress. This makes Oakland an ideal candidate for our efforts to focus on because they would be open to our suggestions.

In an effort to achieve sustainable growth and improvement, Oakland has publicly committed to open data initiatives. This means they periodically publish their data online in the interest of both accessibility to the public and transparency. This enabled us to spend our time developing our model rather than searching for data.

The city currently faces several issues. Among these are a high crime rate and a high wealth inequality, with a large number of the population living in poor-quality housing and less economically advantaged. Sonja Trauss, founder of the SF Bay Area Renters Federation, believes that, The need for affordable housing in Oakland as in San Francisco is undeniable, Trauss says, but it should not be tackled in isolation from the rest of development.[2] This is why we built a model that not only solves problems related to Oakland's need for housing, but also considers other areas of development.

0.3 Goals

The aim of our work is to examine issues that Oakland faces in regards to growth and present the solutions with the greatest potential impact.

The first focus of the work is on city park allocation, sizing, and suggested developments for the smart growth objectives of mixed land uses, creating walkable neighborhoods, preserving open space, and community development.

The second focus is on trying to develop building designs to optimally target new housing and commercial developments for the goals of creating a range of housing opportunities for groups that are not currently serviced by existing developments. Another priority is making development decisions cost effective to optimally allocate housing.

Part II

The Model

0.4 Our Model

Our model pulls statistics from Oakland Zoning data, real estate data and tax data to suggest where improvements can be made. Often we are interested in key statistics, such as distance to a park and price per square foot depending on area and development type.

We aim to suggest where parks have the greatest positive impact, and what kind of housing developments are most appropriate for a given desired development and location. Our model also studies and shows the probable effect of the city's existing development strategies.

Using publicly available zoning information we created a heatmap of the distance to the center of open spaces for different areas in Oakland. We also found the distribution of these distances. This shows the majority of regions to be reasonably close to some sort of outdoor space. Something we hypothesized was key to creating walkable districts, as well as to give them a distinct sense of place. Several regions are further from parks, and these are places we propose focusing on. The core goal of our approach is to identify the areas where our effort would create the most impact.

0.5 Our Results

Analysis of the city of Oakland's data shows some surprising trends. If we look at existing residential developments, we see a distribution across housing costs that looks like Fig. 1

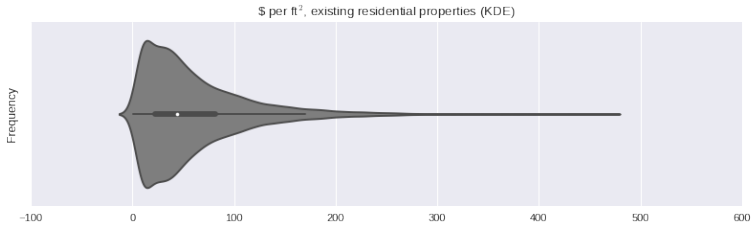

Figure 1: Distribution of price per square foot for residentially zoned properties

This figure makes sense; if we model wealth distribution as a power law distribution, we would expect an initial spike as housing prices have a bottom line, and then an exponential falloff. Indeed, points representing $\$400 + /ft^2$ houses appear very little, with only 18 houses having a greater value than that.

Approved developments follow a very different distribution, as in Fig. 2

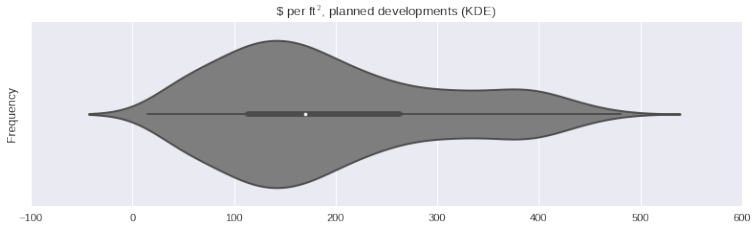

Figure 2:

The two distributions are on the same axis, and we can immediately see the difference. Over 40 houses are planned with $> \$400/ft^2$ values, and the distribution does not look anything like a power law. If we look at where these properties are being developed, we observe a distribution like Fig. 3

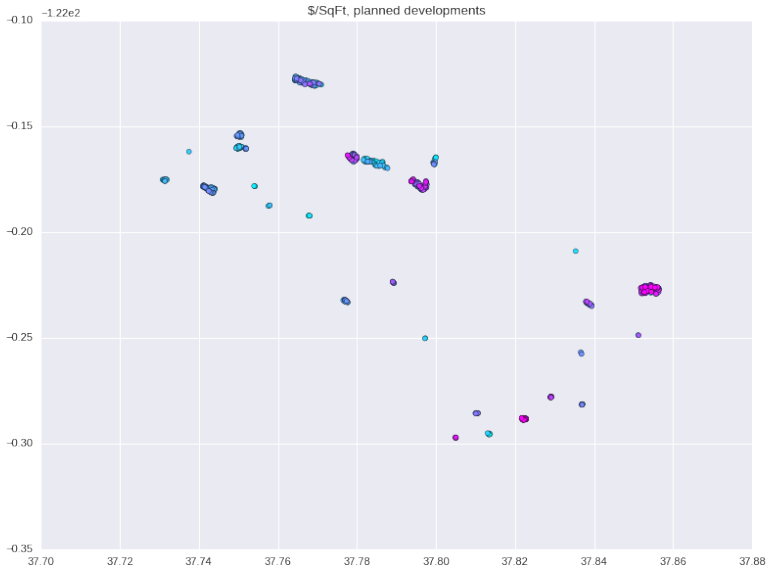

Figure 3:

and compare it to the total map of $\$/ft^2$, Fig. 4

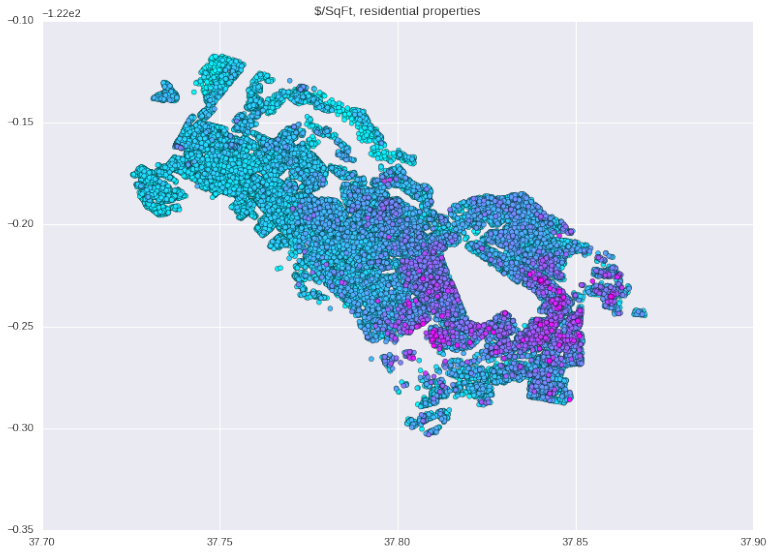

Figure 4:

We can see that the new developments are primarily in high-cost areas, with little development in poorer areas like East Oakland.

This also manifests in commercial valuations (Fig 5), with most concentrating in downtown or along major roads, making those in low-income households have to travel much more.

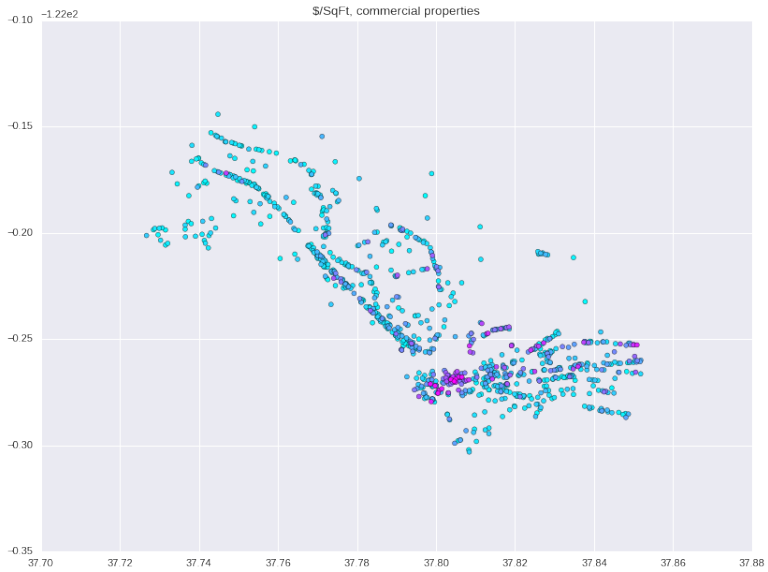

Figure 5:

This is also a very abnormal distribution considering most other developments in the city follow a power law. This is the effect of gentrification on Oakland, something that we can see does not conform to the criteria of smart growth.

If we look at how parks are distributed around the city (Fig. 6), we can see a similar trend dependent on area wealth. While not as pronounced, especially due to large park-zoned areas like the Oakland zoo, the effect is still noticeable. When one considers the relative abundance in crowded downtown areas vs the existence of parks in cheaper east-oakland districts, the correlation is doubly apparent.

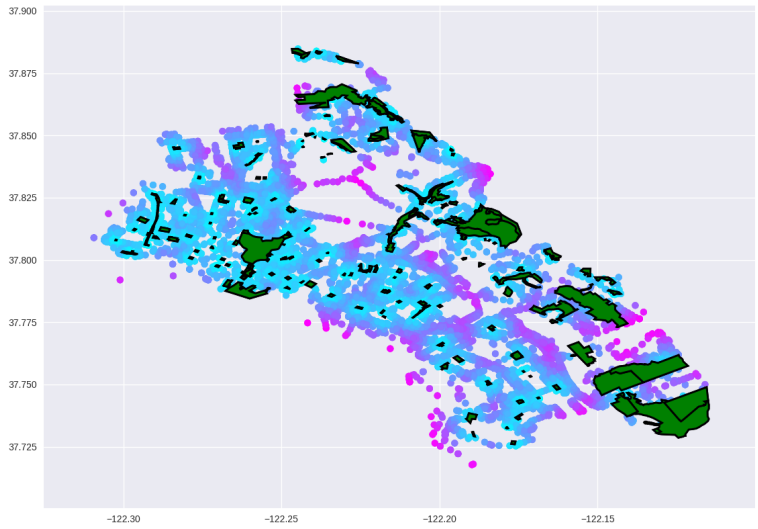

Figure 6:

The park situation exhibits power law distributions in the distance to park (Fig. 7), so the situation isn't terrible, but the average distance is non-trivial, especially in areas of less economic advantage.

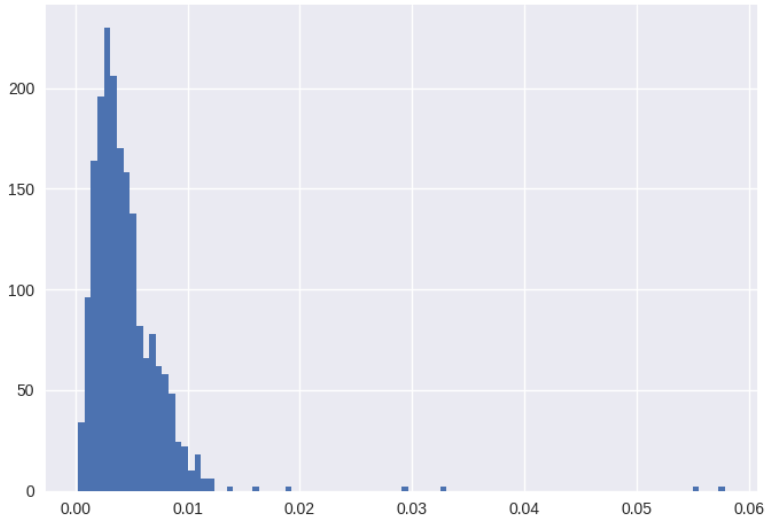

Figure 7:

Our results show the presence of a long tail for most metrics. This indicates that while the majority of the population is within some 'normal' bound a non-trivial population exists below this. For example, although most sections of the city are relatively close to a park, there exist sections where the density is markedly lower, and these areas are correlated with low property value. By identifying the long tail we are able to target our changes to the regions that will be most affected, and which are most in need of change.

Part III

The Answer

0.6 Our Suggestions

Our model is an improvement upon the existing Oakland city-approved development plan. It shows how we can allocate park resources more effectively and optimize housing design. By increasing the amount of local affordable housing, redistributing commercial space and development, and optimizing the allocation of public parks, we believe that our model offers the city of Oakland achievable goals for smart growth.

0.7 Hypothetical Massive Population Growth

Our model is population insensitive, allowing flexibility even in the extreme case of a 50% increase in population.

0.8 Sources

1. https://www.epa.gov/smartgrowth/smart-growth-publication
2. http://www.citylab.com/cityfixer/2016/06/its-time-for-oakland-to-face-its-fears-and-start-building/486803/
3. https://www.oakgov.com/news/Pages/pr_16_112.aspx
4. data.openoakland.org